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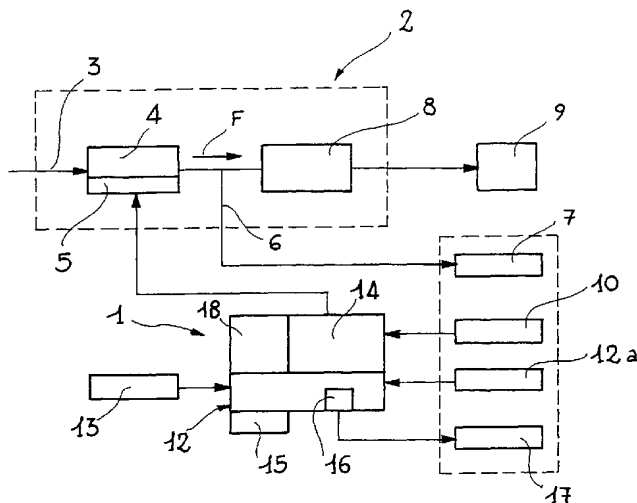
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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: CONTROL UNIT FOR CONTROLLING THE DELIVERY OF A COMBUSTIBLE GAS IN VALVE UNITS, PARTICULARLY FOR WATER HEATING APPARATUSES, AND VALVE UNIT INCLUDING SAID UNIT



(57) Abstract: A control unit is described for controlling the delivery of a combustible gas in a valve unit (2) of the type comprising valve means (4) for shutting off the gas which are subject to the operational control of a magnetic safety unit (5) with thermocouple (10). The control unit comprises an electronic circuit assembly (12) arranged for connection to sensor means (13) adapted to detect the presence of inflammable vapours or other dangerous substances, the circuit assembly (12) being supplied by electric power generating means. The circuit assembly (12) comprises an electronic type switch (14) acting on the electric circuit (11) for supplying the magnetic unit (5) so as to interrupt the circuit and operate the valve means (4) for closure in the presence of inflammable vapours detected by the sensor means (13).

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Control unit for controlling the delivery of a combustible gas in valve units, particularly for water heating apparatuses, and valve unit including said unit.

#### Technical field

5 The present invention concerns a control unit for controlling the delivery of a combustible gas in valve units, particularly for water heating apparatuses.

The invention also relates to a valve unit including the aforesaid control unit.

#### Technological background

10 The invention has its place particularly, but not exclusively, in the field of control of sanitary water heating apparatuses, for example of storage type water heaters for domestic use.

These apparatuses typically comprise valve means, for the delivery of the gas to the burner, with thermostatic control, that is to say, of the type comprising "thermo-mechanical thermostat" control devices which have the advantage of not  
15 requiring any external supply for their operation. Such a control device is described for example in Italian Patent Application No. PD2000A000138 in the name of the same Applicant.

In the specific sector of storage type water heaters it is known to use the aforesaid apparatuses in surroundings such as, for example, garages for parking  
20 motor vehicles and/or storing inflammable materials, such as solvent oils, varnishes, petrol and similar substances. In these cases the liquids or vapours due to the leakage of such substances from the storage containers or to the leakage of fuel from the motor vehicles, may be ignited by the flame present in the burner of the water heater, with dangerous consequences.

25 As at least a partial solution to this problem, the prior art has proposed the use of particular flameproof grilles, at the air inlet openings to the combustion chamber of the water heater. These grilles have very dense meshes which are arranged to confine the flame to the inside of the combustion chamber, preventing its diffusion outside the water heater and consequent spread into the  
30 surrounding atmosphere.

A main limitation of this proposed solution is linked to the fact that these flameproof grilles are easily obstructed and clogged by the dust normally present

in such surroundings, with consequent deterioration of the combustion characteristics, for example due to an increased production of carbon monoxide (CO). All this obviously causes dangerous conditions for persons who are in proximity to the atmosphere surrounding the water heater. There is therefore a  
5 need to control the delivery of the gas in order to shut off its flow whenever inflammable vapours are detected in the atmosphere, for example by the use of sensor means capable of detecting the presence of such substances above the threshold values that may be acceptable.

#### Description of the invention

10 A principal aim of the present invention is that of providing a control unit for controlling the delivery of a combustible gas, capable of processing the values detected by sensor means for controlling the opening and/or closing of the valve means provided for the delivery of the gas to the burner of the water heater.

This aim, and others which will become clear from the following  
15 description, are fulfilled by a control unit for controlling the delivery of combustible gas in valve units having the characteristics defined in the claims which follow.

#### Brief description of the drawings

The characteristics and advantages of the invention will become clearer from the following description of one of its preferred exemplary embodiments  
20 illustrated, by way of non-limiting example, with reference to the appended drawings, in which:

- Figure 1 is a block diagram relating to a control unit for a valve group according to the invention,
- Figure 2 is a diagram corresponding to that of the previous figure in an  
25 alternative embodiment of the invention,
- Figure 3 is a diagrammatic view of a control circuit of the valve unit of the previous figures, interfaced with the control unit according to the invention,
- Figure 4 is a diagrammatic view corresponding to that of figure 3 in a further variant of the invention.

30 Preferred method of implementation of the invention

With initial reference to Figure 1, the reference 1 indicates as a whole a control unit for controlling the delivery of gas in a valve unit 2 of a water heating apparatus, not shown, such as a storage type water heater for domestic use.

5 The combustible gas is fed into the valve unit through a main pipe 3 for the passage of gas.

The valve unit 2 comprises, in the pipe 3, a safety valve 4 operated by a manually set magnetic unit 5, of conventional structure per se, adapted to allow the opening of the valve and the flow of gas in the pipe 3.

10 Downstream of the valve 4, with respect to the direction of flow of the gas (shown by the arrow F in Figure 1), the pipe 3 communicates with a second pipe 6 for supplying the gas to a pilot burner, indicated by 7.

In the main pipe 3 there is further mounted a thermostatically operated servo-valve 8, for regulating the pressure of the gas delivered to a main burner 9. Said servo-valve 8 comprises, in a configuration which is conventional per se, an  
15 actuator means of the thermo-mechanical type, which is controlled by a thermostatic element sensitive to the temperature variation of the water. An example of such an actuator is described in Italian Patent Application No. PD2000A000138 in the name of the same Applicant.

20 The magnetic unit 5 is electrically supplied by the power generated by a thermocouple device 10, heated by the flame of the pilot burner 7.

The magnetic unit 5 and the thermocouple 10 are electrically connected by way of an electric circuit 11 (shown diagrammatically in Figure 3).

25 The control unit comprises, according to the invention, an electronic circuit assembly 12, produced for example in the form of an electronic card, which is interfaced with the valve unit 2 on the one hand, and with a sensor means 13 for sensing inflammable vapours on the other hand, as will become clearer from the continuation of the description.

30 The sensor 13 is conveniently of the type comprising transducer means capable of transforming the signal indicating the presence of inflammable vapours in the surrounding atmosphere, into an electrical magnitude which is sent, as an input signal, to the electronic circuit assembly 12. Such a magnitude

is for example an ohmic resistance R, but other magnitudes may be generated by different transducer means that may be employed.

The circuit assembly 12 also comprises comparison means (not shown) for comparing the resistance value R generated by the sensor 13 with a threshold value preset in the logic of the circuit assembly, so as to generate a signal S for  
5 operating the valve unit, each time the value detected is above the threshold value.

The circuit assembly 12 further comprises an electronic type switch 14, for example with MOSFET type transistor, which is operably connected to the electric circuit 11 of the thermocouple 10 for interrupting said circuit and,  
10 consequently, operating the safety valve 4 so as to shut off the gas pipe 3 when the switch 14 is operated by the signal S generated by the electronic circuit assembly.

More particularly, the electronic switch 14 is of the low ohmic resistance type and is conveniently connected in series, in the circuit 11, with the  
15 thermocouple 10 and the magnetic unit 5 (Figure 3).

The electronic circuit assembly 12, in the interface with the sensor 13, is electrically supplied by thermopile power generating means 12a, which are heated by the flame of the pilot burner 7. Said thermopile means 12a serve to  
20 generate an electrical voltage of the order of at least a few tenths of a volt, necessary for supplying the electronic circuit 12.

The control unit 1 also comprises battery electric power generating means 15, which are arranged to supply electric power principally to the circuit assembly 12, limitedly in the initial phase of lighting the flame at the pilot burner, in which  
25 phase the thermopile means 12a are not yet capable of providing sufficient power to the circuit assembly 12. The use of thermopile generating means advantageously makes it possible to increase the useful duration of the charge of the battery 15.

The battery generating means 15 further serve for electrically supplying an igniter device 16 for lighting the flame of the pilot burner, including an electrode  
30 17 controlled by the circuit assembly 12, such that lighting thereof is disabled in the presence of inflammable vapours detected by the sensor means 13.

The reference 18 indicates an electric push-button by which the igniter 16 is electrically actuated in the phase of lighting of the pilot burner 7.

Provision is further made, with appropriate sizing of the resistive part of the circuit assembly 12 such as to reduce the power consumption, for such  
5 resistive part to be able to be supplied directly by the power produced by the thermocouple device 10.

In operation, provision is made that, initially, the actuator of the magnetic unit 5 is pressed to allow the passage of gas through the pipe 6 as far as the pilot burner 7. While continuing to press the aforesaid actuator, simultaneous  
10 pressing of the electric push-button 18 makes it possible to supply the electrode 17 electrically, by way of the battery 15, with the flame being lit at the pilot burner 7.

Once the flame at the pilot burner has heated the thermocouple 10 sufficiently, the magnetic unit 5 is set and the delivery of the gas is modulated by  
15 means of the thermostatic control of the servo-valve 8.

Whenever the sensor 13 detects the presence of inflammable vapours above the permitted threshold, the ohmic resistance R exceeds the threshold value preset (in the logic of the electronic circuit) and the consequent signal S sent to the electronic switch 14 interrupts the electric circuit 11, disabling the  
20 magnetic unit 5 with the consequent operation of the safety valve 4 for closure and the shutting-off of the gas pipe.

During the phase of lighting of the pilot burner 7 (with the electric push-button 18 pressed), provision is made for the battery 15 to provide sufficient power to supply the electronic circuit 12 such that, in the presence of  
25 inflammable vapours detected by the sensor 13, the electrical ignition discharge at the igniter device 16 is prevented.

Once the flame at the pilot burner 7 is lit, and the phase of normal operation of the valve unit 2 has begun, the thermopile generating means 12a provide sufficient power to supply the electronic circuit, in place of the battery 15.

30 Figure 2 shows the block diagram of an alternative embodiment of the invention, which differs from that of the previous example mainly by the fact that

the igniter device 16 is operated independently of the circuit assembly 12. Such an igniter device is for example of the piezoelectric type.

In operation, this alternative embodiment of the invention differs in that, in the initial ignition phase, simultaneously with the pressing of the actuator of the magnetic unit (for enabling the passage of gas to the pilot burner) the user must  
5 actuate the igniter 16 manually in order to light the flame at the pilot burner. When ignition has occurred, the flame heats the thermocouple 10 which in turn sets the magnetic unit 5 with consequent enabling of the delivery of the gas to the pilot burner.

10 Once the pilot flame is lit, the actuation of the push-button 18 enables the operation of the sensor 13 for detecting any inflammable vapours. In the case where the vapours detected by the sensor 13 exceed the tolerated threshold, the signal S generated and sent to the electronic switch 14 makes it possible, analogously to the previous example, to interrupt the electric circuit 11 with  
15 consequent closure of the safety valve 4 (by release of the magnet of the magnetic unit 5 and urging of the shutter of the valve 4 for closure, for example by means of a resilient spring means).

Figure 4 shows a block diagram, corresponding to that of Figure 3, of a further variant of the invention intended to be applicable to the configuration of  
20 the invention both of Figure 1 and Figure 2.

This further variant, in which details analogous to those of the previous examples are designated by the same reference numbers, differs mainly in that the circuit assembly 12 is electrically supplied exclusively by way of battery means 15, without the assistance of any thermopile generator. Moreover, the  
25 resistive part of the circuit assembly 12 to which the sensor is connected is supplied by the thermocouple. The electric circuit thus produced has a low absorption and allows it to be supplied by means of a battery, at the same time ensuring a long duration of operation.

The invention thus fulfils the aims proposed, by obtaining the advantages  
30 claimed with respect to the known solutions.

## C L A I M S

1. A control unit for controlling the delivery of a combustible gas in a valve unit (2) of the type comprising valve means (4) for shutting off the gas which are subject to the operational control of a magnetic safety unit (5) with thermocouple (10), the control unit comprising an electronic circuit assembly (12) arranged for connection to sensor means (13) adapted to detect the presence of inflammable vapours or other dangerous substances, said circuit assembly (12) being supplied by electric power generating means, the circuit assembly (12) comprising an electronic type switch (14) acting on the electric circuit (11) for supplying the magnetic unit (5) so as to interrupt said circuit and operate said valve means (4) for closure in the presence of inflammable vapours detected by said sensor means (13).

2. A control unit according to claim 1, wherein said electric power generating means comprise thermopile means (12a) supplied by the flame of a pilot burner (7) associated with said valve unit (2).

3. A control unit according to claim 1, wherein said electric power generating means are of the type with battery (15) and the circuit assembly (12) is arranged to be electrically supplied exclusively by said generating means with battery (15).

4. A control unit according to one of claims 1 to 3, wherein said sensor means (13) comprise transducer means adapted to transform the signal indicating the presence of inflammable vapours into an electrical magnitude sent to the circuit assembly, said circuit assembly (12) comprising comparison means for comparing the value of such a magnitude with a preset threshold value and consequently sending an operating signal (S) for opening said electronic switch (14), whenever the value of said magnitude is above the threshold value set.

5. A control unit according to claim 4, wherein said magnitude is an ohmic resistance (R).

6. A control unit according to claim 2, wherein the resistive part of the electronic circuit assembly (12) is electrically supplied by said thermocouple (10).

7. A control unit according to one or more of the preceding claims, wherein said electronic switch (14) is of the low resistance type and is connected



in series with the thermocouple (10) and the magnetic unit (5) in said circuit (11) for supplying same.

8. A control unit according to one or more of the preceding claims, wherein said electronic switch (14) is of the type with MOSFET transistor.

5 9. A control unit according to one or more of the preceding claims, further comprising electric power generating means with battery (15) which are arranged for electrically supplying the circuit assembly (12), limitedly in a phase of ignition of the pilot burner (7) and until the power produced by the thermopile generating means (12a) is sufficient to supply the electronic circuit assembly  
10 (12).

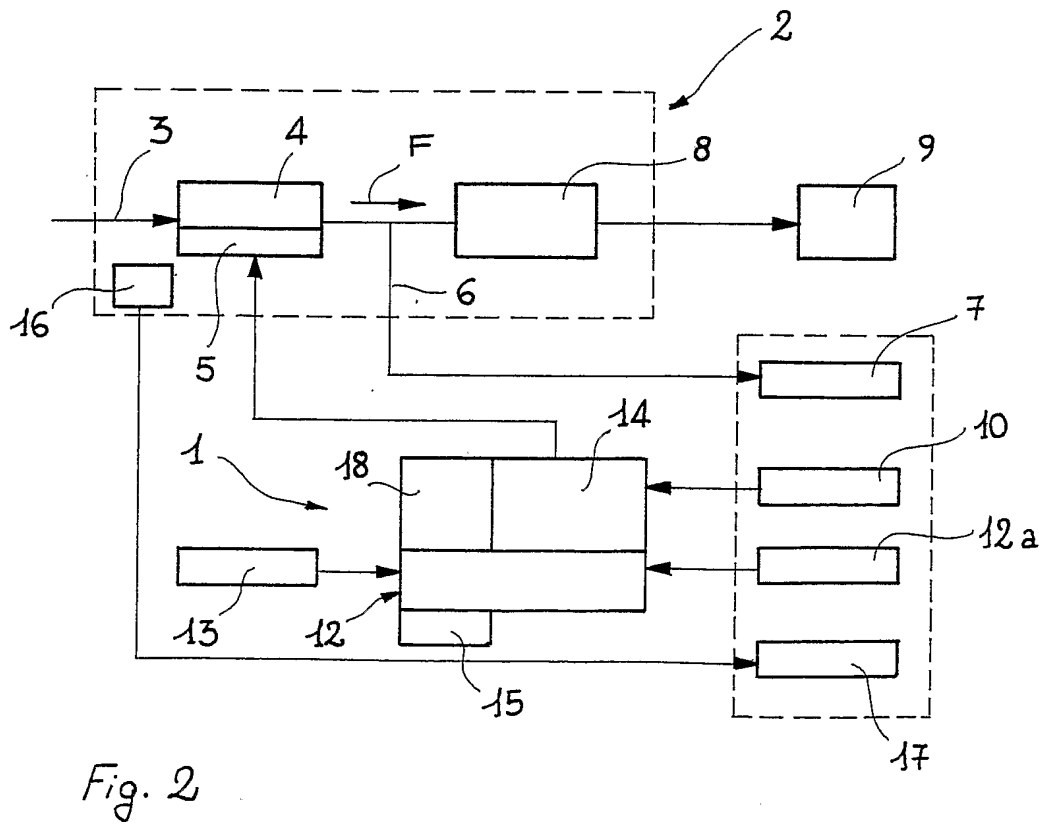
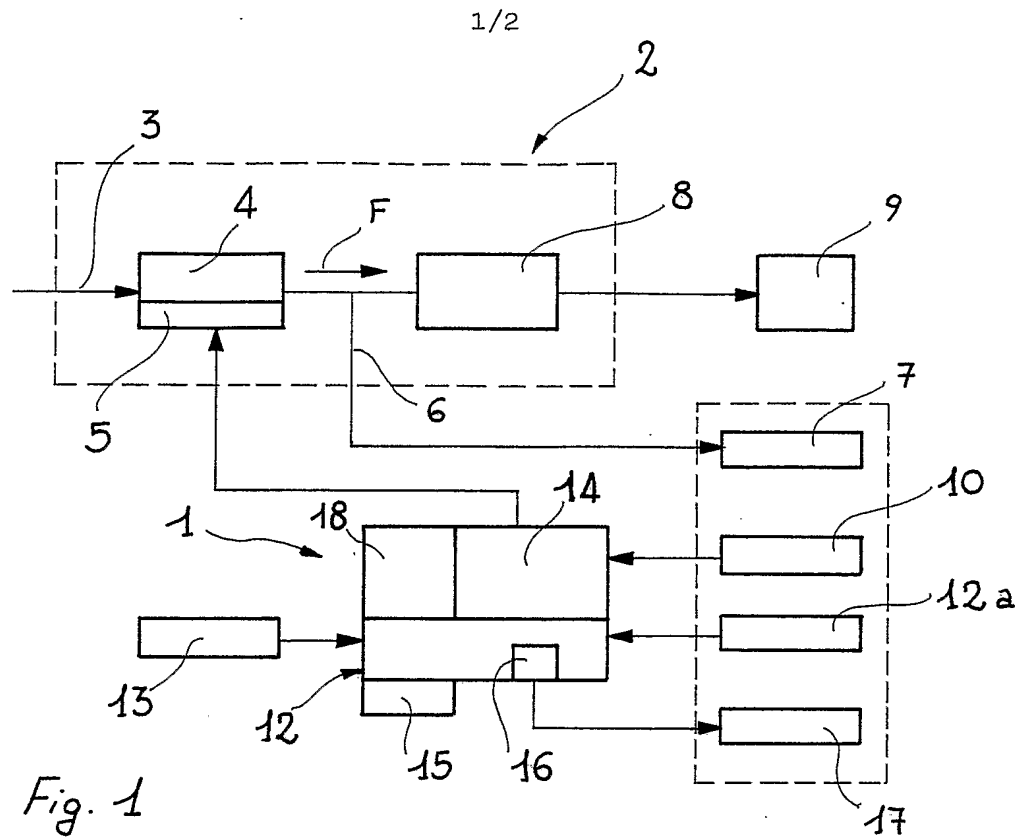
10. A control unit according to one or more of the preceding claims, wherein said generating means with battery (15) are electrically connected to an igniter device (16) for lighting the flame of the pilot burner (7) to provide sufficient power to said device (16) in the flame ignition phase.

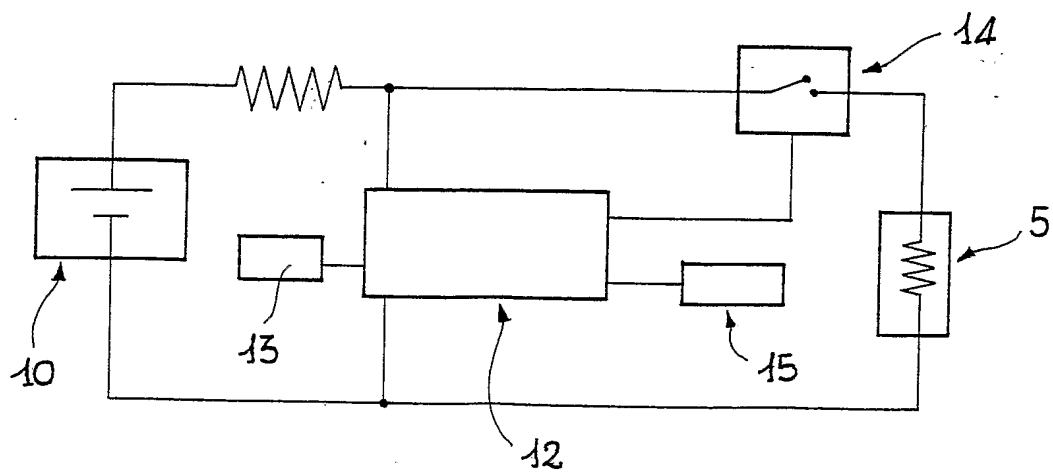
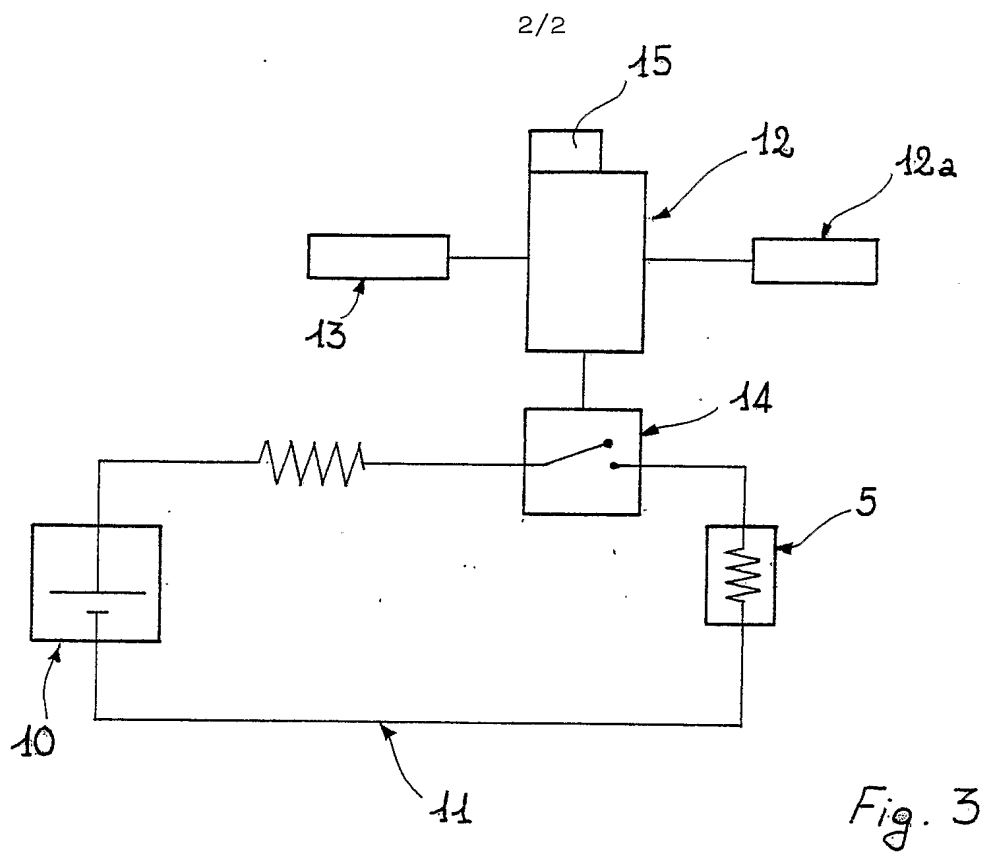
15 11. A control unit according to claim 10, wherein said igniter device (16) is controlled by said circuit assembly (12) to be disabled in the presence of inflammable vapours detected by said sensor means (13).

12. A control unit according to one or more of claims 1 to 9, wherein an igniter device (16) for lighting the flame at the pilot burner (7) is provided,  
20 operated independently of the circuit assembly (12).

13. A control unit according to claim 12, wherein said igniter device (16) is of the piezoelectric type.

14. A valve unit for the delivery of a combustible gas, particularly in water heating apparatuses, comprising a control unit (1) for controlling the  
25 delivery of the gas according to one or more of the preceding claims.





## INTERNATIONAL SEARCH REPORT

International application No

PCT/IT 02/00409

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 F23N5/24

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 F23N F23G F23D F24H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2001/038986 A1 (ABRAHAM ANTHONY W ET AL) 8 November 2001 (2001-11-08)	1,4,5
Y	page 1, paragraph 5 -page 2, paragraph 24	2,3,6-11
X	US 5 419 358 A (SUN YUNG) 30 May 1995 (1995-05-30) column 1, line 45 -column 4, line 25; figures 1,2	1,4,12
Y	US 5 816 791 A (HOME WILLIAM) 6 October 1998 (1998-10-06) column 2, line 7 -column 3, line 21; figure 1	2,3,6, 9-11
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☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

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## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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